(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 171 039 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
15.08.2007 Bulletin 2007/33

(21) Application number: **00925446.7**

(22) Date of filing: **13.04.2000**

(51) Int Cl.:
A61B 8/12 *(2006.01)*

(86) International application number:
PCT/GB2000/001412

(87) International publication number:
WO 2000/061006 (19.10.2000 Gazette 2000/42)

(54) IMPROVEMENTS IN OR RELATING TO ULTRASOUND DEVICES

ULTRASCHALLGERÄTE

PERFECTIONNEMENTS APPORTES A DES DISPOSITIFS ULTRASONORES

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE

(30) Priority: **13.04.1999 GB 9908427**

(43) Date of publication of application:
16.01.2002 Bulletin 2002/03

(73) Proprietor: **Deltex (Guernsey) Limited**
St. Peter Port, Guernsey (GB)

(72) Inventor: **SMITH, Leonard**
Ringwood,
Hampshire BH24 2PA (GB)

(74) Representative: **Newstead, Michael John et al**
Page Hargrave
Southgate
Whitefriars
Lewins Mead
Bristol BS1 2NT (GB)

(56) References cited:
WO-A-00/24318
WO-A-93/05713
WO-A-93/06776
WO-A-94/10921
GB-A- 2 266 371
US-A- 5 425 375

EP 1 171 039 B1

Description

Field of the Invention

[0001] This invention relates to an ultrasound device and, in particular, to a disposable ultrasound probe insertable into a body cavity to enable ultrasound insonation of internal vessels and organs. Aspects of the invention may, however, be applied to other non-invasive ultrasound devices such as those which are placed in contact with the body outer surface.

Background

[0002] Ultrasound is widely used in medicine for imaging and/or diagnostic purposes. An example of an ultrasound-based medical device can be found in published International Patent Application WO 93/06676. It discloses a disposable ultrasound device with an electronic memory which functions in ' conjunction with a host processor for monitoring a patient, the memory communicating with the host processor and storing the patient's weight, and height.

[0003] In one known form of device, ultrasound transmit and receive crystals are mounted on the tip of a probe which, in use, is located within the body so that specific organs or vessels can be subjected to ultrasound insonation and the reflected signals then analysed to give particular diagnostic information. In another form of device, the transmit and receive crystals are mounted in contact components designed to be held in contact with the body outer surface adjacent the organs or vessels to be insonated.

[0004] This company has, for some time, been manufacturing and selling an instrument for determining cardiac function. This instrument incorporates a disposable probe which is inserted into the patient's oesophagus, the probe having mounted on the outer end thereof, ultrasound transmit and receive crystals. In use, the probe is aligned so that the crystals are aligned substantially at 45° to the patient's descending aorta and are thus arranged to insonate a section of the descending aorta with ultrasound.

[0005] The probe is specifically designed and intended as a disposable device yet medical staff will, in some situations, still attempt to re-use probes on other patients. This practice carries with it a risk of cross-infection. Further, successive sterilisations intended to reduce the risk of cross-infection, can lead to a breakdown of the probe components which are not designed for such treatment.

[0006] A further characteristic of these disposable probes is that the level of ultrasound to which the patient is subjected, will vary from probe to probe. Typically this is because the receive and transmit crystals are mass manufactured from commercial grade materials and are thus susceptible to quality, and thus performance, variations.

[0007] It is therefore an object of this invention to provide an ultrasound device which will go at least some way in addressing the above-mentioned drawbacks, or which will at least provide a useful choice.

Summary of the Invention

[0008] Accordingly, in one aspect, the invention provides a method of controlling the use of a disposable ultrasound device having an electronic memory, said method comprising the steps of: using said device in conjunction with a host processor for monitoring physiological behaviour in a patient;

causing said electronic memory to communicate with said host processor,

storing in said memory patient physical data, said data being weight, height and/or age; and

preventing said host processor from communicating to said electronic memory any variation in said patient physical data.

[0009] Preferably said method includes storing in said electronic memory an acceptable total time of use of said device, and preventing said host processor from further operating in conjunction with said device when said device has been in use for said acceptable total time.

[0010] Preferably said method includes causing said host processor to record a date of first use of said device in said electronic memory, and causing said host processor to no longer function with said device at a predetermined time after said date of first use.

[0011] Preferably the date of manufacture of said device is recorded in said electronic memory, said method further including causing said host processor to no longer function in conjunction with said device after the passage of a predetermined period of time after said date of manufacture.

[0012] In a second aspect the invention provides a Doppler ultrasound cardiac function monitor including:

a disposable ultrasound probe having an electronic memory; and a host processor connectable to said probe to enable communication with said electronic memory,

said memory being configured to store patient physical data, said data being weight, height and/or age; and

said host processor being configured to prevent any variation of said patient physical data from being communicated to said electronic memory.

[0013] Preferably said electronic memory is further configured and operable to store information relating to the accumulated time of use of said probe, said memory

containing a counter of remaining time available for use, said counter declining whilst said probe is in use.

[0014] Preferably said electronic device includes a plurality of counters, said host processor maintaining a host counter initiated from that one of said time counters in electronic memory indicating the lowest remaining time of use, said host processor updating the permissible remaining time of use alternatively between said counters in memory.

[0015] Preferably said probe includes a connector for connection thereof to said processor, said electronic memory being included in said connector.

[0016] Preferably said electronic memory comprises an E^2PROM.

[0017] Said probe may further include one or more transducers operable to monitor predetermined patient parameters. Such parameters may, for example, comprise temperature or pulse oxygen levels.

[0018] Many variations in the way the present invention can be performed will present themselves to those skilled in the art. The description which follows is intended as an illustration only of one means of performing the invention and the lack of description of variants should not be regarded as limiting.

[0019] Wherever possible, a description of a specific element should be deemed to include equivalents thereof. The scope of the invention is defined in the appended claims

Brief Description of the Drawings

[0020] One form of the invention will now be described with reference to the accompanying drawings in which:

Figure 1: shows a schematic system outline of a Doppler ultrasound cardiac output monitor incorporating an ultrasound probe according to the invention;

Figure 2: shows a plan view of an ultrasound probe according to the invention;

Figure 3: shows a schematic outline of the electronic components included in the probe shown in Figure 2; and

Figure 4: shows a schematic outline of certain electronic components incorporated in a patient interconnect cable and arranged to operate in conjunction with the components shown in Figure 3.

Detailed Description of Working Embodiment

[0021] Referring to the drawings, the present invention provides a disposable ultrasound transmit and receive device for use in conjunction with a host processor to provide diagnostic and/or imaging data derived from a human subject. Whilst such a device could be adapted for contacting the body outer surface , the following description is directed to a probe 5 insertable into a human body cavity (not shown).

[0022] The particular form of probe herein depicted and described comprises a disposable oesophageal probe for use in a Doppler ultrasound cardiac function monitor. In this application, the probe is connected to a host system processor 7 which causes the probe 5, when located in a patient's oesophagus, to emit ultrasound in the direction of the descending aorta, and to receive signals reflected off red blood cells moving through the aorta. The ultrasound signals are then processed to give a measure of blood velocity. Details of patient weight, height and age are also processed within the host system processor, according to an accepted statistically based method, to give a measure of aorta cross section, the resulting measure of cross section then being combined with blood velocity to give an indication of cardiac function.

[0023] In the form of apparatus shown in Figure 1, the probe 5 is connected to the host system processor 7 through a patient interconnect cable (PIC) 9, all the components having electronic components which will be described, at least in part, below.

[0024] In the conventional manner, the probe 5 comprises a flexible elongate shaft member 11, at the free end of which ultrasound receive and transmit crystals (not shown) are mounted, the ultrasound crystals being covered by a soft plastics or rubber boot 13. The opposite end of the shaft 11 carries a connector 15 whereby the probe may be connected into the host system processor 7, in this case via the PIC 9.

[0025] In accordance with this invention, the probe 5 has embodied therein, an electronic memory which can receive and store probe/patient use parameters. Some parameters may be entered into memory in manufacture whilst others will be inserted when the probe is connected to the host system processor 7.

[0026] In use, the host processor communicates with the memory in the probe in relation to one or more of the parameters which are stored in memory. In the case of some parameters, the host processor will render the monitor inoperative if the parameter monitored in real time varies from its stored value in a predetermined way. By way of example, a maximum permissible time of use may be recorded in the memory embedded in the probe. When the actual time of use equates to the total period of permissible use, the host system processor recognises the fact and the monitor will no longer function with that probe attached.

[0027] In the case of other parameters, the host system processor 7 may simply decline to allow a variation in the parameter to be accepted with that particular probe connected. For example, when initial patient use data selected from the group of age, weight and height have been entered in the memory embedded in the probe, the host system processor will recognise that this data has

been recorded and will not allow any variation thereto.

[0028] In the form shown in Figures 2 and 3, the electronic memory is embodied in the connection 15 between the probe 5 and the PIC 9. More particularly the connection 15 is preferably defined, in part, by a printed circuit board 17, edge part 19 of which projects to form a connection with the PIC 9, and part 21 of which is enveloped in an insulating cover 22. The electronic memory, preferably in the form of an E ^{2}PROM 23, is mounted on the printed circuit board 17.

[0029] Whilst the memory is preferably in the form of an E ^{2}PROM and is described herein as such, it will be appreciated by those skilled in the art, that the memory could take other forms, eg a flash ROM.

[0030] The PIC 9 obviously provides an electrical connection with the host system processor 7 and may include pre-amplification means to amplify the receive signals from the probe before transmission to the host system processor 7.

[0031] In use, when a new probe 5 is connected to host system processor 7, the date of first use, as advised by the system processor, is immediately recorded in E ^{2}PROM 23. The host processor also interrogates the timer locations in memory and, if the probe is new and these locations are empty, the host processor allocates a maximum allow time of use to these memory locations. Alternatively, as part of the manufacturing process, the memory 23 could be programmed with a total time of permissible use.

[0032] Thereafter, a counter in the processor 7 continually measures the time of use and periodically updates the E ^{2}PROM 23 by subtracting the elapsed time of use from the total permissible time of use remaining in memory 23. When permissible time stored in E^{2}PROM 23 reaches zero, the host system processor 7 is triggered and thereafter declines to operate with that particular probe connected.

[0033] To guard against the possibility of power failure or cut-off while the host processor is updating the time counter in memory 23, memory 23 preferably includes two locations or counters which are updated alternately by the host processor 7. Thus, the host processor reads both counter locations and updates the higher reading. In normal operation, the internal counter in the system processor 7 updates the probe counters every hour however, when the internal counter in the host processor 7 reaches zero, the host immediately writes both counters in E^{2}PROM 23 to zero. Thereafter, as soon as the monitor is switched off, or the probe 5 is disconnected, the probe 5 will no longer operate with a host processor 7. The host system processor is also programmed to render the probe inoperable after a predetermined time has elapsed after the date of first use (say four days), regardless of whether or not time remains in the time counters forming part of E ^{2}PROM 23.

[0034] During manufacture, the E ^{2}PROM 23 is preferably also programmed with date of manufacture, thus allowing a "shelf life" to be built into the probe. Upon connection, the host system processor will interrogate the date of manufacture and if the connection date exceeds the date of manufacture by a predetermined length of time, the host processor 7 will decline to function with that probe connected.

[0035] As stated above, the probe 5 as described herein, is designed to form part of a cardiac function monitor which uses a statistically based method, based on patient age, weight and height, to determine typical aortic cross sectional area. Thus, the memory 23 in the probe 5 is configured to receive details of age, weight and height of a particular patient into whom the probe is to be inserted.

[0036] Upon initial connection, the host system processor 7 interrogates E ^{2}PROM 23 to determine if patient age weight and height have been recorded. If not, the host processor 7 calls for the monitor operator to enter and confirm these details. Once entered and confirmed, a host processor connected to the probe 5 will not allow these details to be amended.

[0037] Turning now to Figures 3 and 4, the probe 5, PIC 9 and system processor 7 incorporate an industry standard communications bus, in this case a Philips I ^{2}C bus, to allow data to be passed therebetween. To this end, connector edge part 19 on the probe connector 15 includes pins SDA and SCL for the serial data and serial clock lines respectively. These engage with the corresponding SDA and SCL pins on the PIC 9 and lead back to the host system processor, to enable communication between the host system processor 7 and the E ^{2}PROM 23. Power and decoupling device C1 is provided to power and decouple the E^{2}PROM 23.

[0038] Pin PP on the probe contacts corresponding PP on the PIC 9 (Figure 4), the PP connection on the PIC 9 serving not only to indicate when a probe is connected to the PIC 9 but also, to release the SDA line for the passage of data between the processor 7 and the probe 5. More particularly, and with reference to Figure 4, when there is no probe present, Q1, R7 and C7 hold the SDA line low at just over 0 volts. When a probe is present, PP on the PIC 9 is held low (connected to ground) and Q1, R7 and C7 release the SDA line to pass data. Thus the SDA line provides the dual function of passing data and indicating the connection, or not, of a probe.

[0039] PIC 9 receives power at 5 volts from the host processor 7 and uses this power to power E ^{2}PROM 23, but includes components R6,C6 (25) to filter out noise induced in the PIC cable.

[0040] The use of a disposable probe 5 with a PIC 9 having the amplification facilities mentioned, allows extra capability to be built into the probe. For example, the probe could be provided with one or more additional transducers (not shown) to allow patient physiological parameters such as, for example, temperature or pulse oxygen to be monitored - preferably simultaneously with cardiac function.

[0041] There are further advantages in including a memory device in the probe. For example, the device

can store calibration information relating to the probe which will increase the likelihood of the patient being subjected to uniform levels of insonation. Due to variations arising in the high volume manufacture of the crystal materials used for the ultrasound transmit and receive components, performance variations are inevitable from one probe to another and this could lead to patients being subjected to varying levels of power.

[0042] With a view to ensuring patients are subjected to substantially known and constant levels of power, the desired output characteristics of the probe can be written into the E ^{2}PROM 23 during manufacture and, at the end of the production process, a signal of known characteristics applied to the probe and the resulting probe response also stored in the E ^{2}PROM to give a calibration factor. The system processor 7 can be programmed to apply this calibration factor during use of the probe to ensure a consistent transmit power output.

[0043] In use, whether calibrated or not, a probe 5 is connected to PIC 9 and to host system processor 7. Assuming the probe has not previously been used, the system processor 7 will note that the clock counters contain the full permitted time of use and will also note that the patient data register is empty. The monitor, under the control of host system processor 7, will then call for patient age, weight and height to be entered and confirmed and, upon the data being so entered and confirmed, will pass this to memory 23. As the probe is used, the clock register in E ^{2}PROM 23 is continuously counted-down until the permitted use time reaches zero. Thereafter the processor 7 will not allow the monitor to function with that particular probe in place. In a similar manner, the system processor communicates with the patient physical data first entered in memory 23 and will not allow any variation thereof.

[0044] It will thus be appreciated that the present invention, at least in respect of the preferred form of apparatus described herein, provides a form of ultrasound probe which remains inexpensive to manufacture but which guards against re-use.

Claims

1. A method of controlling the use of a disposable ultrasound device (5) having an electronic memory (23), said method comprising the steps of: using said device in conjunction with a host processor (7) for monitoring physiological behaviour in a patient;

   causing said electronic memory (23) to communicate with said host processor
   storing in said memory (23) patient physical data, said data being weight, height and/or age; and
   preventing said host processor (7) from communicating to said electronic memory (23) any variation in said patient physical data.

2. A method as claimed in claim 1 including storing in said electronic memory (23) an acceptable total time of use of said device (5), and preventing said host processor (7) from further operating in conjunction with said device (5) when said device has been in use for said acceptable total time.

3. A method as claimed in any one of claims 1 to 2 including causing said host processor (7) to record a date of first use of said device (5) in said electronic memory, and causing said host processor to no longer function with said device at a predetermined time after said date of first use.

4. A method as claimed in any one of claims 1 to 3 wherein the date of manufacture of said device (5) is recorded in said electronic memory (23), said method further including causing said host processor (7) to no longer function in conjunction with said device (5) after the passage of a predetermined period of time after said date of manufacture.

5. A Doppler ultrasound cardiac function monitor including:

   a disposable ultrasound probe having an electronic memory (23); and
   a host processor (7) connectable to said probe to enable communication with said electronic memory (23),
   said memory (23) being configured to store patient physical data, said data being weight, height and/or age; and
   said host processor (7) being configured to prevent any variation in said patient physical data from being communicated to said electronic memory.

6. A monitor as claimed in claim 5 wherein said electronic memory (23) is further configured and operable to store information relating to the accumulated time of use of said probe, said memory containing a counter of remaining time available for use, said counter declining whilst said probe is in use.

7. A monitor as claimed in claim 6 wherein said device (5) includes a plurality of counters, said host processor (7) maintaining a host counter initiated from that one of said time counters in electronic memory indicating the lowest remaining time of use, said host (7) processor updating the permissible time of use alternatively between said counters in memory.

8. A monitor as claimed in any one of claims 5 to 8 wherein said probe includes a connector (15) for connection thereof to said processor (7), said electronic memory (23) being included in said connector (15).

9. A monitor as claimed in any one of claims 5 to 8 wherein said electronic memory (23) comprises an E^2PROM.

10. A monitor as claimed in any one of claims 5 to 8 further including one or more transducers operable to monitor predetermined patient parameters.

11. A monitor as claimed in claim 10 wherein said patient parameters comprise temperature or pulse oxygen levels.

Patentansprüche

1. Verfahren zur Kontrolle der Verwendung einer Wegwerf-Ultraschallvorrichtung (5) mit einem elektronischen Speicher (23), wobei das Verfahren die folgenden Schritte umfasst:

   Verwendung der Vorrichtung zusammen mit einem Wirtsrechner (7) zur Überwachung des physiologischen Verhaltens bei einem Patienten;
   Veranlassen des elektronischen Speichers (23) zur Kommunikation mit dem Wirtsrechner;
   Speichern physischer Patientendaten im Speicher (23), wobei es sich bei den Daten um Gewicht, Größe und/oder Alter handelt; und
   Abhalten des Wirtsrechners (7) von der Übertragung jedweder Variation der physischen Patientendaten an den elektronischen Speicher (23).

2. Verfahren nach Anspruch 1, das Folgendes einschließt: Speichern einer akzeptablen Gesamtgebrauchszeit der Vorrichtung (5) im elektronischen Speicher (23) und Abhalten des Wirtsrechners (7) vom weiteren Betrieb zusammen mit der Vorrichtung (5), wenn die Vorrichtung für die akzeptable Gesamtzeit in Gebrauch gewesen ist.

3. Verfahren nach einem der Ansprüche 1 bis 2, das Folgendes einschließt: Veranlassen des Wirtsrechners (7) zum Aufzeichnen eines Datums vom ersten Gebrauch der Vorrichtung (5) im elektronischen Speicher und Veranlassen, dass der Wirtsrechner an einem prädeterminierten Zeitpunkt nach dem Datum des ersten Gebrauchs nicht mehr mit der Vorrichtung funktioniert.

4. Verfahren nach einem der Ansprüche 1 bis 3, wobei das Herstellungsdatum der Vorrichtung (5) im elektronischen Speicher (23) registriert ist, wobei das Verfahren weiter Folgendes einschließt: Veranlassen, dass der Wirtsrechner (7) nach Ablauf einer prädeterminierten Zeitdauer nach dem Herstellungsdatum nicht mehr zusammen mit der Vorrichtung (5) funktioniert.

5. Doppler-Ultraschall-Herzfunktionsmonitor, der Folgendes einschließt:

   eine Wegwerf-Ultraschallsonde mit einem elektronischen Speicher (23); und
   einen Wirtsrechner (7), der an die Sonde anschließbar ist, um die Kommunikation mit dem elektronischen Speicher (23) zu ermöglichen,

   wobei der Speicher (23) zum Speichern physischer Patientendaten konfiguriert ist, wobei die Daten Gewicht, Größe und/oder Alter darstellen; und
   wobei der Wirtsrechner (7) konfiguriert ist, um abzuhalten, dass jedwede Variation der physischen Patientendaten an den elektronischen Speicher übertragen wird.

6. Monitor nach Anspruch 5, wobei der elektronische Speicher (23) weiter konfiguriert und betrieben wird, um Informationen in Bezug auf die akkumulierte Gebrauchszeit der Sonde zu speichern, wobei der Speicher einen Zähler der restlichen zum Gebrauch zur Verfügung stehenden Zeit enthält, wobei der Zähler rückwärts zählt, während sich die Sonde in Gebrauch befindet.

7. Monitor nach Anspruch 6, wobei die Vorrichtung (5) eine Vielzahl von Zählern einschließt, wobei der Wirtsrechner (7) einen Wirtszähler aufrechterhält, der von dem einen der Zeitzähler im elektronischen Speicher initiiert wird, wobei die niedrigste zum Gebrauch verbleibende Zeit angezeigt wird, wobei der Wirtsrechner (7) die zulässige Gebrauchszeit abwechselnd zwischen den Zählern im Speicher aktualisiert.

8. Monitor nach einem der Ansprüche 5 bis 8, wobei die Sonde einen Konnektor (15) zum Anschluss davon an den Rechner (7) einschließt, wobei der elektronische Speicher (23) im Konnektor (15) eingeschlossen ist.

9. Monitor nach einem der Ansprüche 5 bis 8, wobei der elektronische Speicher (23) ein E^2PROM umfasst.

10. Monitor nach einem der Ansprüche 5 bis 8, der weiter einen oder mehr betriebsfähige(n) Transducer zur Überwachung prädeterminierter Patientenparameter einschließt.

11. Monitor nach Anspruch 10, wobei die Patientenparameter die Temperatur oder Puls-Sauerstoffspiegel umfassen.

Revendications

1. Méthode de contrôle de l'usage d'un dispositif ultrasons à jeter (5) muni d'une mémoire électronique (23), ladite méthode comprenant les étapes qui consistent à : utiliser ledit dispositif conjointement avec un processeur hôte (7) pour le monitorage du comportement physiologique d'un patient ;

   provoquant la communication entre ladite mémoire électronique (23) et ledit processeur hôte, enregistrant les données physiques du patient dans ladite mémoire (23), lesdites données étant le poids, la taille et/ou l'âge ; et
   empêchant audit processeur hôte (7) de communiquer toute variation dans lesdites données physiques du patient à ladite mémoire électronique (23).

2. Méthode selon la revendication 1 incluant l'enregistrement dans ladite mémoire électronique (23) d'un durée d'utilisation totale acceptable dudit dispositif (5), et empêchant audit processeur hôte (7) de continuer à fonctionner conjointement avec ledit dispositif (5) quand ledit dispositif a été utilisé pendant ladite durée totale acceptable.

3. Méthode selon la revendication 1 ou la revendication 2 incluant la provocation de l'enregistrement par le dit processeur hôte (7) d'une date de première utilisation dudit dispositif (5) dans ladite mémoire électronique, et provoquant l'interruption du fonctionnement dudit processeur hôte avec ledit dispositif à un moment prédéterminé après ladite date de première utilisation.

4. Méthode selon l'une quelconque des revendications 1 à 3 dans laquelle la date de fabrication dudit dispositif (5) est enregistrée dans ladite mémoire électronique (23), ladite méthode incluant, en outre, la provocation de l'interruption du fonctionnement dudit processeur hôte (7) conjointement avec ledit dispositif (5) après l'écoulement d'une période de temps prédéterminée après ladite date de fabrication.

5. Moniteur de la fonction cardiaque ultrasons Doppler incluant :

   une sonde ultrasons à jeter munie d'une mémoire électronique (23) ; et
   un processeur hôte (7) raccordable à ladite sonde pour permettre la communication avec ladite mémoire électronique (23),
   ladite mémoire (23) étant configurée de manière à enregistrer les données physiques du patient, lesdites données étant le poids, la taille et/ou l'âge ; et
   ledit processeur hôte (7) étant configuré pour empêcher la communication de toute variation dans lesdites données physiques du patient à ladite mémoire électronique.

6. Moniteur selon la revendication 5 dans laquelle ladite mémoire électronique (23) est en outre configurée et utilisable pour enregistrer des informations ayant trait à la durée d'utilisation accumulée de ladite sonde, ladite mémoire contenant un compteur du reste du temps disponible pour l'utilisation, ledit compteur diminuant durant l'utilisation de ladite sonde.

7. Moniteur selon la revendication 6 dans laquelle ledit dispositif (5) inclut une pluralité de compteurs, ledit processeur hôte (7) maintenant un compteur hôte initié à partir de l'un desdits compteurs de temps dans la mémoire électronique indiquant la durée d'utilisation restante la plus courte, ledit processeur hôte (7) actualisant la durée d'utilisation permissible alternativement entre lesdits compteurs dans la mémoire.

8. Moniteur selon l'une quelconque des revendications 5 à 8 dans laquelle ladite sonde inclut un connecteur (15) pour la connexion de celle-ci audit processeur (7), ladite mémoire électronique (23) étant incluse dans ledit connecteur (15).

9. Moniteur selon l'une quelconque des revendications 5 à 8 dans laquelle ladite mémoire électronique (23) comprend une E^2PROM.

10. Moniteur selon l'une quelconque des revendications 5 à 8 incluant, en outre, un ou plusieurs transducteurs utilisables pour contrôler les paramètres prédéterminés du patient.

11. Moniteur selon la revendication 10 dans laquelle lesdits paramètres du patient comprennent la température ou les taux d'oxygène pulsé.

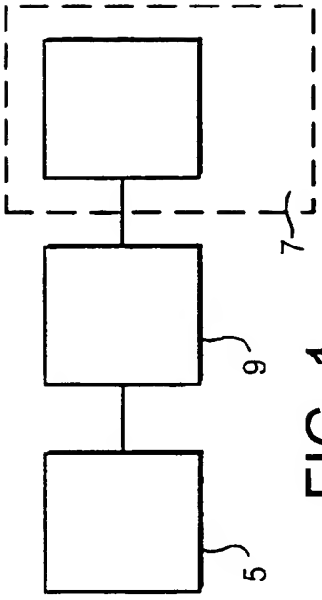

FIG. 1

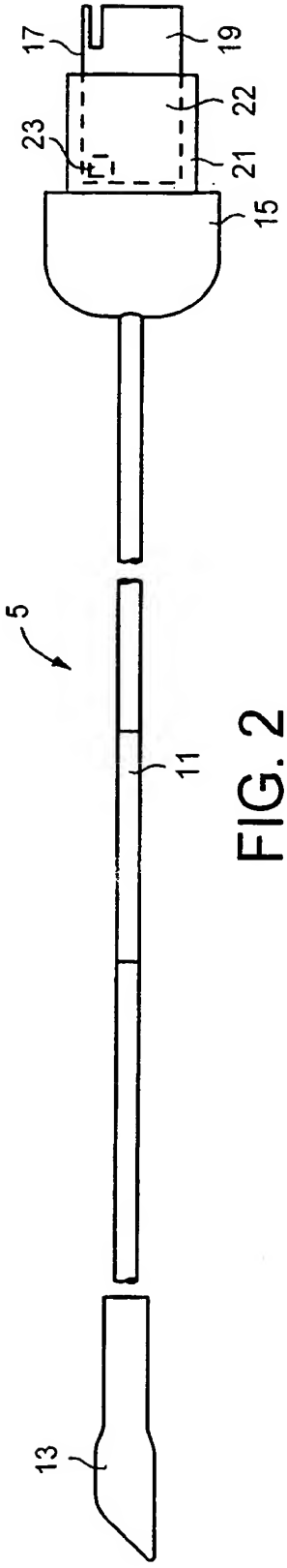

FIG. 2

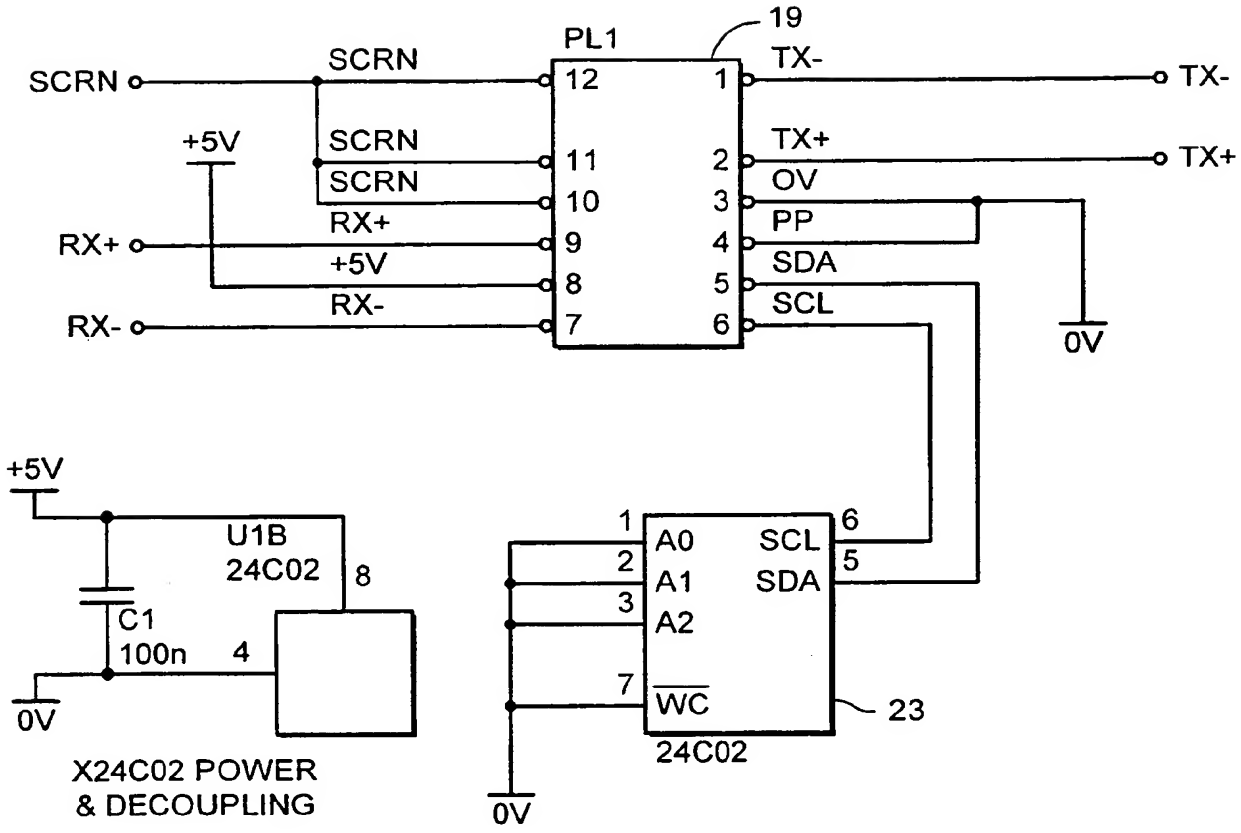
PL1
19
SCRN
SCRN
12
1
TX-
TX-
+5V
SCRN
11
2
TX+
TX+
SCRN
10
3
OV
RX+
RX+
9
4
PP
+5V
8
5
SDA
RX-
RX-
7
6
SCL
0V
+5V
U1B
24C02
8
C1
100n
4
0V
X24C02 POWER
& DECOUPLING
1
A0
SCL
6
2
A1
SDA
5
3
A2
7
WC
23
24C02
0V

FIG. 3

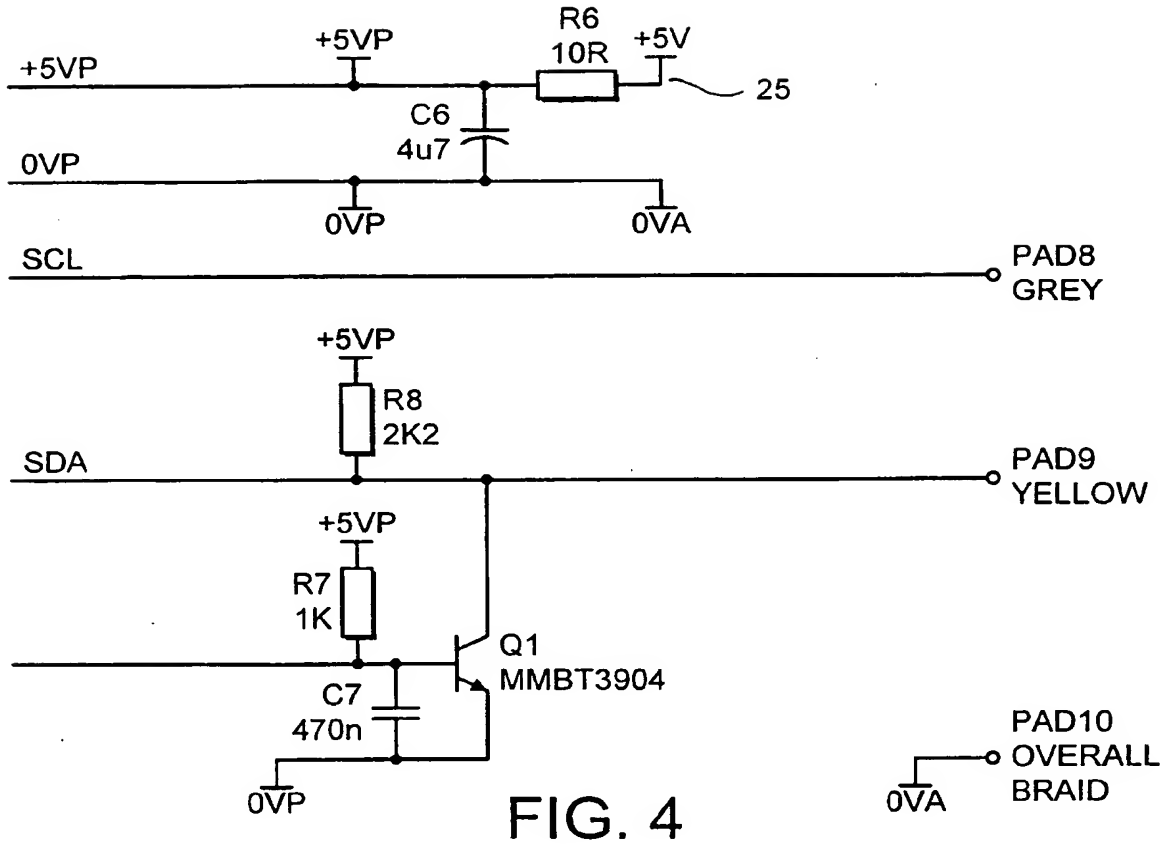
+5VP
+5VP
R6
10R
+5V
25
C6
4u7
0VP
0VP
0VA
SCL
PAD8
GREY
+5VP
R8
2K2
SDA
PAD9
YELLOW
+5VP
R7
1K
Q1
MMBT3904
C7
470n
0VP
PAD10
OVERALL
BRAID
0VA

FIG. 4

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 9306676 A **[0002]**